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positions of planet, Sun, and Earth, less than one magnitude between brightness at conjunction and at opposition.

Saturn is getting into better position for evening observation. On November 1st it rises at 10:20 P. M., and at about six in the evening at the end of December. It is in *Cancer* and moves eastward up to November 12th. During the rest of the period it moves about 2° westward. The apparent minor axis of the rings is very slightly larger than it was during the last period, but is distinctly smaller than the polar axis of the planet.

Uranus sets shortly before midnight on November 1st and before 8 P. M. on December 31st, but is still in fair position for evening observation. It remains in the constellation *Capricornus,* moving 1° 42′ eastward and 34′ northward during the month. On November 1st it is a little less than 1° west and 0°.5 north of the small fourth magnitude ι *Capricorni.* On December 12th it passes 0°.7 north of the star, a distance about one-third greater than the apparent diameter of the Moon.

Neptune is in *Cancer* east of the position of *Saturn.*

THE SAN DIEGO MEETING OF THE PACIFIC DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, AND OF THE ASTRONOMICAL SOCIETY OF THE PACIFIC.

The first meeting of the Pacific Division of the American Association for the Advancement of Science was held in San Diego, August 9 to 12, 1916, and was a success from every point of view. The officers and committees of the Pacific Division and of those of the affiliated societies which held meetings in conjunction with that of the Pacific Division planned the programs carefully, and the local committee on arrangements made every possible provision for the comfort and entertainment of the visiting members. The local committee was generously assisted in its work by the San Diego Chamber of Commerce, the Woman's Board of the Panama-California International Exposition, the staff at the Scripp's

Institution for Biological Research at La Jolla, the U. S. Bureau of Fisheries thru the officers and scientific staff of the *Albatross,* and by a number of firms engaged in commercial work of scientific interest; e. g., the kelp-reduction plants, the salt works and the tuna canneries.

The dedication exercises of the Scripp's Institution for Biological Research, La Jolla, were held on the afternoon of the opening day of the meeting, Wednesday, August 9. President B. I. Wheeler presided, and, after the invocation pronounced by the Bishop of Los Angeles, Rt. Rev. Joseph H. Johnson, addresses were made by Dr. David Starr Jordan, Dr. D. T. MacDougal, Professor G. H. Parker, and Professor Wm. E. Ritter, the scientific director of the institution.

Headquarters for the Pacific Division had been established in the lobby of the U. S. Grant Hotel and the general sessions of the Division were held in the assembly hall of the hotel on the evenings of Wednesday, Thursday, and Friday, August 9, 10, and 11. In opening the first meeting, on Wednesday evening, Dr. W. W. Campbell, president of the Pacific Division, called attention to the fact that this was the initial meeting of the Division and briefly outlined the history of the movement that led to its formation. He then introduced Hon. Lyman J. Gage, who welcomed the members of the Pacific Division and of the participating societies to San Diego. Dr. D. T. MacDougal, chairman of the executive committee of the Division, responded, and the address of the evening was then given by Dr. Campbell on the subject "What We Know About Comets." This address, which was fully illustrated by lantern slides, will soon be published, and no attempt will be made to give an abstract of it here. A very pleasant informal reception concluded the evening's program.

At the general session on Thursday evening the speaker was Dr. Barton W. Evermann, Director of the Museum, California Academy of Sciences, San Francisco, who chose for his subject, "Modern Natural History Museums and Their Relation to Public Education."

At the third general session, on Friday evening, Dr. Frank F. Wesbrook, president of the University of British Columbia, Vancouver, spoke on "The Physician of Tomorrow."

Good audiences were present on all three evenings—indeed, the attendance at all of the meetings—the separate scientific meetings as well as the general sessions was encouragingly large.

On Thursday evening a brief business meeting was held at which the present executive committee was re-elected, and it was voted that the choice of the next president and of the time and place of the next meeting be left to this committee.

The scientific sessions of the participating societies were held in various rooms of the San Diego High School building in the forenoons and afternoons of Thursday and Friday. Saturday was devoted to excursions to points of interest in the neighborhood of the city and at 7 o'clock of that evening the members of the Division gathered in the dining room of the U. S. Grant Hotel for the final function of the session—the Association dinner. Dr. E. L. Hardy, principal of the San Diego Normal School, acted as toastmaster, and appropriate addresses were made by Drs. F. R. Burnham and Fred Baker of San Diego, and by Messrs. W. W. Campbell, J. C. Merriam and F. F. Wesbrook.

In the absence of the president and other officers of the society, the meeting of the Astronomical Society of the Pacific on Thursday morning, August 10, was opened by the chairman of the program committee, Dr. R. G. Aitken. At his request Dr. W. S. Adams of the Solar Observatory, Mount Wilson, presided at the morning session, which was entirely devoted to a symposium on the nebulæ. The animated discussion of all the papers presented at this and at the later sessions proved their interest to the members present, and formed a most profitable feature of the meetings.

At the afternoon session, Dr. W. W. Campbell, of the Lick Observatory, was called to the chair. The papers at this session related principally to spectroscopic investigations. The remaining papers were presented at the session held on Friday forenoon, over which Professor Charles Burckhalter of the Chabot Observatory was called to preside. The closing remarks of the meeting were made by Dr. Campbell.

On the following pages brief abstracts are given of all of the papers, in the order in which they were read, except of those which appear in full on other pages of this number. For these, titles and references are given.

FORMS OF PLANETARY NEBULÆ: *Heber D. Curtis.*

The forms of fifty planetary nebulæ have been studied with the Crossley Reflector, using varying lengths of exposure times in order to get the structural detail of the very bright central portions as well as the fainter outlying parts of the planetary nebulæ. The majority of the planetaries show a more or less regular ring or shell structure, generally with a central star. Lantern slides were exhibited showing the various types observed.

SPECTROGRAPHIC OBSERVATIONS OF RELATIVE MOTIONS WITHIN THE PLANETARY NEBULÆ:

W. W. Campbell and *J. H. Moore.*

In the past nine months, as opportunity offered, the D. O. Mills three-prism spectrograph and the 36-inch Lick telescope in combination have searched for rotation effects in thirty-three planetary nebulæ. Definite evidence of rotation has been observed in sixteen nebulæ and suspected in five others. For twelve nebulæ no evidence of rotation was obtained, possibly because the axis of rotation in some of these may be pointing approximately toward the earth, in which case the spectroscopic method would not be applicable.

In the nebulæ which are more and more condensed as the center is approached, we seem to be dealing with simple cases of rotating bodies, with the outer strata rotating more slowly than the strata nearer the center. In other nebulæ showing ring structure with central nuclei, rotation effects seem to be combined with other forms of motion.

The central sections of the bright lines in the spectra of several nebulæ are bowed toward the red and widened. The interpretation which suggests itself is that the nebular materials serving as the source of light—presumably those in the hemisphere nearest the observer—are moving in toward the nebular nucleus. This hypothesis at least calls for careful consideration.

The results give valuable evidence as to the probable masses of the planetary nebulæ. They seem to contain sufficient material to form systems more extensive than our solar system.

The paper is illustrated with lantern slides of a few of the nebulæ and their spectra.

THE ROTATION AND RADIAL VELOCITY OF THE SPIRAL NEBULA N. G. C. C. 4594: *Francis G. Pease.*

A spectrum photograph of this nebula of 80 hours exposure with the 60-inch reflector is approximately of type F5. The slit was set along the major axis of the greatly elongated ellipse which marks the boundary of the nebula—the object is nearly edge-on to the observer. Light was thus received from points at different distances from the nucleus. An extraordinary feature is that the relation between radial velocity and distance is sensibly linear, thus:

$$\text{Velocity} = -2.78\,x + 1180$$

in which x is the distance from the center in seconds of arc.

The radial velocity of the system is accordingly 1180 km/sec., while the rotation velocity at a distance of $2'$ is 330 km/sec. Assuming the rotational component to be the same as that derived by van Maanen for Messier 101, the parallax is found to be of the order of $0''.0001$.

COLOR PHOTOGRAPHS OF NEBULÆ: *Frederick H. Seares.*

Slides are shown illustrating the distribution of color in several of the spiral nebulæ. Photographs on ordinary plates compared with others on isochromatic plates exposed behind a yellow filter show that the nuclei are yellow or reddish, while the branches, and especially the condensations scattered along them, are intensely blue and possess a photographic activity similar to that of the central star in the Ring Nebula. The planetary N. G. C. 3242, on the other hand, shows no important differences in the intensity distribution of its blue and yellow light.

SPECTROGRAPHIC OBSERVATIONS OF NEBULÆ AND STAR CLUSTERS: *V. M. Slipher.*

The continuation of the spectrographic observations of nebulæ and clusters reported upon in 1914, at Evanston, has not—by the inclusion of additional objects—much changed the average radial velocity of 400 km/sec. for the spiral nebulæ. Other spirals have been found to show rotational displacements and several spectrograms of the Great Andromeda Nebula fully confirm the earlier indications of the rotation of this nebula. Some interesting types of nebular spectra have been met with, the most remarkable case being that of the Crab Nebula in *Taurus* in which the chief nebular bright lines seem to be split into two components suggesting the Stark electric field analysis for hydrogen, helium and lithium.

The radial velocity of the globular clusters is less than that of the spiral nebulæ and their spectra are blends of early and later type stars with the relative intensities of the types varying from cluster to cluster.

ON THE MOTION OF NEBULOUS FILAMENTS IN N. G. C. 6992:

C. O. Lampland.

The intricate structure and definite character of some of the filaments in the nebula N. G. C. 6992 should make it possible to detect comparatively small changes that may take place. Two photographs of this object, separated by an interval of about fourteen years, were examined with a Zeiss comparator equipped with a Blink-Mikroskop. The earlier photograph was a copy on glass of Professor Ritchey's fine photograph of this nebula and the one of later date was from a negative made with the 40-inch reflector of the Lowell Observatory. In the south part of the nebulosity there are apparently slight displacements of small portions of some of the filaments.

VARIABLE STARS IN THE LAGOON NEBULA, N. G. C. 6523:

C. O. Lampland.

Four negatives of the Lagoon Nebula, made with the 40-inch reflector in July, 1915, have been examined with the Zeiss comparator and twelve variables have been found in different parts of the nebulosity. Most of these stars are faint, in the neighborhood of the sixteenth and seventeenth magnitude, and as a rule the variation in brightness is small, roughly a magnitude, except for three of the stars where variations from two to three magnitudes are shown.

A SIMPLE METHOD FOR DETERMINING THE COLOR OF A STAR: *Frederick H. Seares.*

With suitable precautions the ratio of the exposure times necessary for the blue and yellow light of a star to produce photographic images of the same size is a reliable measure of the star's color. The precision is sufficient for even a single photograph to show the greater redness of stars of high luminosity, spectral type remaining the same.

NOTES ON STELLAR CLUSTERS: *Harlow Shapley.*

The investigation of magnitudes in clusters, reported on for Messier 13 a year ago, has been extended to six additional globular systems. For Messier 3, 5, and 15 a study of the relation between color index and magnitude shows that the brighter stars in all of these clusters are redder than those of the 15th and 16th magnitude, a result confirming that obtained for Messier 13. Preliminary results for Messier 4, 9, and 14 also agree in showing the decrease of color with brightness. The absence of light-scattering material in space is verified by the new data. In Messier 9 some new variable stars have been found. The variables in Messier 3 are found to be similar in color to the isolated cluster-type variables, which they resemble in range and other peculiarities of light variation.

A RELATION BETWEEN THE CONVERGENCE WAVE-LENGTHS IN SPECTRAL SERIES AND THE RADII OF THEIR RESPECTIVE ATOMS AS COMPUTED FROM EINSTEIN'S PHOTO-ELECTRIC EQUATION AND BY OTHER METHODS: *Fernando Sanford.*

It seems to be very definitely established that electrons discharged from metals under the stimulus of ultra-violet light have, after leaving the metal, velocities such that their kinetic energies are given by Einstein's equation, $\frac{1}{2}mv^2 = h\nu - p$, where h = Planck's constant, ν = the vibration frequency of the incident light and p = the work required to remove an electron from the metal. Before leaving the metal the energy of a discharged electron must accordingly have been $\frac{1}{2}mv^2 = h\nu$.

If this energy be regarded as the energy of revolution of the electron about its electropositive sub-atom with the frequency of the incident light, it can be shown that the period of rotation would be proportional to the square of the orbital radius, and, hence, if this electron were itself a source of radiation, the wave-length of its radiation would be proportional to the square of its orbital radius.

$$\text{Thus } \tfrac{1}{2}mv^2 = h\nu. \quad \text{Hence } v^2 = \frac{2h\nu}{m}.$$

$$\nu = \frac{3 \times 10^{10}}{\lambda}.$$

$$h = 6.57 \times 10^{-27}$$

$$m = 10^{-27}$$

$$\frac{h}{m} = 6.57$$

$$v^2 = \frac{6.57 \times 6 \times 10^{10}}{\lambda} = \frac{39.4 \times 10^{10}}{\lambda}$$

$$\text{Also } v = 2\pi R\nu = 6.28 \times \frac{3 \times 10^{10}}{\lambda} \times R,$$

$$\text{and } v^2 = \frac{355.3 \times 10^{20} \times R^2}{\lambda^2}$$

Equating these two values of v^2 and dividing by λ, we have

$$\frac{R^2}{\lambda} = 1.1 \times 10^{-11}.$$

The above assumption of electrons revolving in elliptical or circular orbits would necessitate the assumption of a different electronic radius for each line of the spectrum, and would not enable us to say anything definite about *an* atomic radius. However, since many of the elements have spectral series which seem to converge toward a shortest possible wave-length[f] for that particular system, we may calculate the shortest possible electronic radius for each spectral series. The fact that no electron can revolve about the positive nucleus of this particular system closer than the electron which would give the convergence wave-length seems to justify the assumption that the convergence radius represents the true radius of the central electropositive atom. If this assumption be correct, the convergence wave-lengths of corresponding series in similar elements should be proportional to the square of the respective atomic radii.

Unfortunately, atomic radii can be determined only approximately. Heydweiller has calculated atomic radii for a considerable number of atoms from the refraction constants of their ions in dilute water solutions, using the Lorenz-Lorentz formula and adopting the assumption made by the authors of this formula that the ratio $\frac{n^2 - 1}{n^2 + 2}$ represents the ratio of the real to the apparent atomic volume. Numbers which are generally regarded as proportional to the atomic radii may also be obtained by taking the cube roots of the atomic volume in the liquid or solid state.

It is shown in the paper that the atomic radii computed from Einstein's equation are approximately twice the atomic radii as computed by Heydweiller, and that for a number of groups of similar elements the atomic radii computed from the convergence wave-lengths are closely proportional to both Heydweiller's radii and the cube roots of the atomic volume.

It is also shown that in the Ritz formula,

$$\nu = A - \frac{N_0}{\left(n + a + \frac{b}{n^2}\right)^2}$$

not only the convergence wave-length but the constant "a" may be computed from the atomic radii. In the case of gaseous elements whose atomic volumes are not known this gives still two methods of computing atomic radii.

RECENT STELLAR SPECTROSCOPIC RESULTS: *Walter S. Adams.*

This paper contains some recent determinations of stellar parallaxes by the spectroscopic method, including observations on stars of measured parallaxes and Barnard's star of very large proper motion. Also results for the radial velocities of some of the large proper motion stars of low luminosity, and a discussion of their motions with relation to spectral type. Reference is made to a few spectroscopic binaries of exceptional interest.

THE MEASUREMENT OF CLOSE PAIRS OF SOLAR LINES:

Charles E. St. John and *L. W. Ware.*

This is a study of the errors of measurement of close pairs of solar spectrum lines based on plates taken under different conditions, in different orders, with a scale ranging from 1.8 to 0.25 angstrom per mm, and measured by two or more observers by means of micrometer settings on the maxima and on the edges of lines and by microphotometer curves.

Whenever lines are so close together that the background between them differs in intensity from the continuous background, a tendency toward over-separation appears, more marked for the closer pairs. For pairs with components of intensity 3 or 4, the limit below which the effect is felt in micrometer measures is from 0.10 to 0.15 A for the region investigated, λ3900—λ5270, being less for the sharper cut lines at the blue end. Any condition operating towards loss of sharpness in definition—a widening of the slit, a change from best focus, exposure or development not adapted to the lines under consideration—tends to increase the error. That the last of these affects the Rowland plates, exposed and developed for the general run of lines, is probable, and would explain differences such as those found for the 22 pairs studied; namely, 0.003, 0.008 and 0.013 A for mean separations of 0.276, 0.145 and 0.075 A, respectively.

The difference in contrast for the two edges of a component of a close pair, when one edge is seen against the dense background of the continuous spectrum and the other against the less dense region of overlap between the two components, shifts the estimated position of the maximum of such a line towards the side of greater contrast. The result is a measured separation slightly too large, but important because systematic.

THE SUGGESTED MUTUAL INFLUENCE OF FRAUNHOFER LINE: *Charles E. St. John.*

The mutual influence of Fraunhofer lines is an accepted deduction from the anomalous dispersion hypothesis. For closely adjacent lines the assumed dissymmetry of the dispersion bands is such that the violet and red components of close pairs are displaced to the violet and red, respectively; that is, the separation is greater in solar than in arc spectra.

The mean Sun — arc displacement for 213 stable iron lines of groups *a, b,* and *c4* of the Mount Wilson classification is +0.0039 A; that for 30 lines with companions at an average distance of 0.31 A to the red is +0.0042 A; that for 59 lines with companions at an average distance of 0.27 A to the violet is +0.0040 A. The three values being equal within the limits of error shows the absence within these limits of mutual influence.

The separations of the components in 45 close pairs have been measured upon separate plates for the Sun and arc. The mean separations in solar and arc spectra are 0.231 and 0.232 A, respectively. The equality shows again the absence of a measurable mutual repulsion.

A comparison of the Rowland and International wave-lengths of the iron lines shows for the violet and red components of close pairs apparent displacements of 0.007 and 0.005 A to the violet and red, respectively, (Albrecht). The wave-lengths of the 104 lines used by Albrecht have been measured upon plates of high dispersion with neighboring isolated lines as standards. These indicate errors in Rowland which are systematic, the violet and red components of close pairs having tabular values respectively too small and too large. Large and small Rowland errors correspond to large and small Albrecht deviations, the coefficient of correlation being +0.56 ±0.05. The probable explanation is that the errors and deviations are two phases of the same phenomenon. The deviations do not then furnish valid proof of mutual influence, while the Sun — arc displacements and the equality of separation in solar and arc spectra indicate its absence within the limits of error.

OBSERVATIONS WITH HIGH DISPERSION OF THE LINE λ 6708 IN LABORATORY AND IN SUN-SPOT SPECTRA:

Arthur S. King.

An extended series of experiments with the arc and the electric furnace have shown that the line λ 6708 is in all cases due to lithium, the hypothesis that calcium under certain conditions might show such a line being disproved. The line is highly complex, two distinct sets of components appearing as the amount of vapor in the source is changed.

Measurements of a strong line in the spectra of sun-spots showed so close an agreement with the laboratory measures of λ 6708 as to leave little doubt that lithium is present in the solar atmosphere, tho apparently able to show its spectrum only in the cooler regions over sun-spots.

NOTE ON BARNARD'S PROPER MOTION STAR: *R. G. Aitken.*

Micrometer measures were made with the 36-inch refractor on June 14 and June 20, connecting Barnard's remarkable proper motion star (R. A. 17^h 54^m; Decl. + 4° 27′) with the 8.7 magnitude star, B. D. + 4°.3560, which precedes it and with two 13th magnitude stars which follow it. These measures were repeated on the nights of July 22 and 26. From these measures, covering a period of 37 days, an annual proper motion of 9″.48 in position angle 344°.34 results.

Miss Jessica M. Young has compared two plates of this star taken with the Crossley reflector on June 20 and July 20, and has deduced an annual proper motion of 8″.84 in 354°.14.

These results are of interest in showing the possibility of obtaining approximately correct values of the proper motion of this remarkable star in a period of only one month.

As seen in the 36-inch refractor, the star has a decided orange color and is about 10.5 magnitude.

NOTE ON THE SPECTRAL TYPE AND THE RADIAL VELOCITY OF BARNARD'S PROPER MOTION STAR: *W. W. Campbell and J. H. Moore.* See page 207.

A LUMINOUS OBJECT SEEN ON MAY 4, 1916: *C. D. Perrine.* See page 176.

A LUMINOUS OBJECT SUSPECTED TO BE A COMET: *A. Estelle Glancy.* See page 179.

RECENT OBSERVATIONS OF THE DIURNAL CHANGE IN THE REFRACTION, AT LICK OBSERVATORY: *R. H. Tucker.*

The purpose of the observations is to check the existence of the diurnal change in refraction, which was found in the reductions of earlier fundamental observations, and to fill in the interval of three hours each side of noon, for which determinations were lacking. The discussion of the diurnal change was first published in *L. O. Bulletin,* No. 231, in 1913.

For the noon values, *Polaris* and *β Ursæ Minoris,* at lower culmination, have been generally employed, as most stars at lower altitudes are invisible in full daylight near noon. A list of over twenty stars of large zenith distances, both north and south, has also been observed, giving determinations of the refraction, from four hours preceding sunset up to nearly midnight.

The results confirm the values derived from the fundamental observations of 1905 and 1906. Observations of zenith distance made here indicate a correction to the Poulkova Refractions of approximately $-0''.2$ tan Z. D. for the night work. The correction begins to diminish before sunrise, changes sign, and reaches a value of approximately $+0''.3$ tan Z. D. in full daylight.

The change sets in, with reversed sign, before sunset, continuing until the mean value for the night is reached.

Diagrams show the variations, both by plotting the values of individual sets, and by combining all the observations into hourly means.

The total variation is about one per cent of the refraction correction.

The important requirement of such an investigation is to free the results from the effect of any other sources of systematic error. Thus the error of standard star declinations must be considered, and must be eliminated. Graduation errors, variations of nadir reading, latitude variation, flexure and bisection errors must be similarly treated. Also the question of atmospheric dispersion, affecting the images of bright stars at low altitudes, has been investigated.

PRELIMINARY NOTE ON THE DETERMINATION OF THE LONGITUDE OF THE STUDENTS' OBSERVATORY BY WIRELESS SIGNALS FROM ARLINGTON: *R. T. Crawford.* See page 208.

THE CHABOT OBSERVATORY: *Charles Burckhalter.*

The Chabot Observatory was presented to the Board of Education of Oakland in 1884, by Mr. Anthony Chabot, and was to be forever free to the public and public schools; the cost was about fifteen thousand dollars. The location was, unfortunately, in the heart of the city. In a few years, when electric lighting was in general use, certain kinds of work could not be carried on until after midnight, and, later, not at all. Then the director asked the Board of Education to move the Observatory to a favorable location, or close it entirely. Also, if moving prevailed, to add a large telescope, as the eight-inch, while a fine telescope, had come to be only of very moderate size, on account of the great increase in size of later instruments. Both recommendations were approved, and, as soon as possible, the telescope was ordered.

The successful bidder was the Warner & Swasey Co. for $19,100. The telescope has a clear aperture of twenty inches, with a focal length of twenty-eight feet. The objective is of Jena glass; the disks, in leaving Germany, missed the British blockade by only three days.

Mr. Brashear, the maker, declares it to be fully the equal in light-grasp to any twenty-five inch lens of the glass heretofore used. This would leave but four refractors in this country that exceed it. The instrument was finished in time to form part of the exhibit of the Warner & Swasey Co. at the Exposition.

Five sites were offered to the Board, free, and the Park Commission offered any site in the City Parks, but none of them was altogether satisfactory. A site was finally secured for $6000 that is nearly ideal. It is shielded from the city light by an intervening ridge, and the topography of the surrounding conditions is such that no future buildings can seriously interfere with the Observatory. It is freer from fog than any part of Oakland, and has a twenty-minute street car service, with five-cent fare.

The site contains twelve acres, to which future streets will add four more.

The building is far enough advanced to use the telescope and it is expected to continue to completion as soon as the budget for the present fiscal year has been passed.

Notes on Certain Double Star Orbits: *R. G. Aitken.*

A revised orbit of β 1111, based on an observed arc of 210° was presented. The elements are:

$P = 39.2$ years
$T = 1917.67$
$e = 0.33$
$a = 0''.23$
$\omega = 127^\circ.9$
$i = \pm 40.7$
$\Omega = 59.0$

This orbit, which offers no difficulties to the computer, was shown as a contrast to the orbits of double star systems in which the inclination of the orbit plane is nearly, but not quite, 90°, and the eccentricity quite high.

Systems of this type, of which there are many representatives, present a maximum of difficulties to the computer, and it is generally impossible to calculate a satisfactory orbit until the completion of at least one revolution. Half a dozen examples were shown, including Σ 1865, *ζ Bootis,* for which a first orbit was given, on the assumption that the companion is now in the fourth quadrant. The resulting elements are:

$P = 139$ years
$T = 1898.5$
$e = 0.96$
$a = 0''.89$
$\omega = 48^\circ.8$
$i = \pm 62.0$
$\Omega = 158.8$

Except for the eccentricity, these elements are quite uncertain, and the uncertainty is principally due to the lack of measures at the time of minimum separation and to the discordance of the observed distances.

The writer believes that the practice of making measures under poor observing conditions or with inadequate instruments is largely responsible for the discordant observations.

COMET *b* 1916 (Wolf): *R. T. Crawford* and *D. Alter.* See below.

NOTE ON AETHRA: *D. Alter.* See page 210.

JOHN WINTHROP (1714-1779), AMERICA'S FIRST ASTRONOMER AND THE SCIENCE OF HIS PERIOD: *F. E. Brasch.* See page 153.

NOTES FROM PACIFIC COAST OBSERVATORIES.

COMET *b* 1916 *(Wolf).*

The second comet of the year 1916 was discovered photographically by Wolf at Heidelberg, the evening of April 27th. It is of peculiar interest in several respects.

After the announcement of the discovery Professor Barnard at the Yerkes Observatory found that he had the object on plates he had taken three nights previous to the discovery plate of Wolf. This observation of April 24 is the earliest one available.

The computations show that at discovery the comet was about 4.1 astronomical units distant from the Earth and nearly 4.9 astronomical units from the Sun, distances greater than those of any other comet at the time of discovery. Even Halley's Comet, whose position for its last return was quite accurately known, was picked up on this return when a little over three astronomical units away. It was found eight months before its perihelion passage date, while Wolf's Comet, altho unexpected, was discovered nearly fourteen months before it will come to perihelion.

On account of the great distance at the time of discovery and the consequent slow motion of the comet, a large range of solutions was possible for orbits that would represent the early observations. This was very apparent in the progress of the first computations. Were it not for the fact that the